

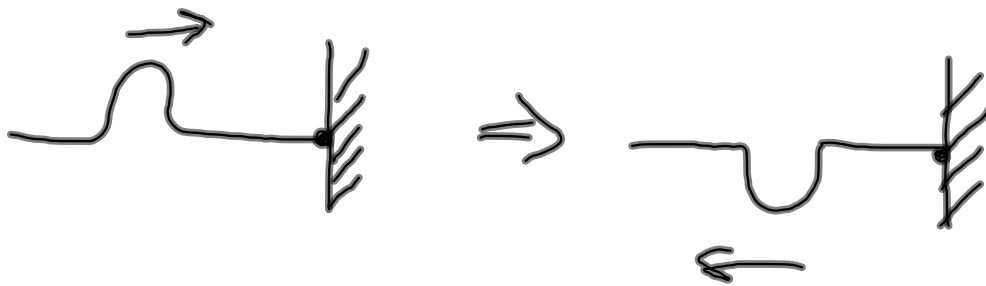
Test Friday, 5/4

- Waves
- Sound
- Light

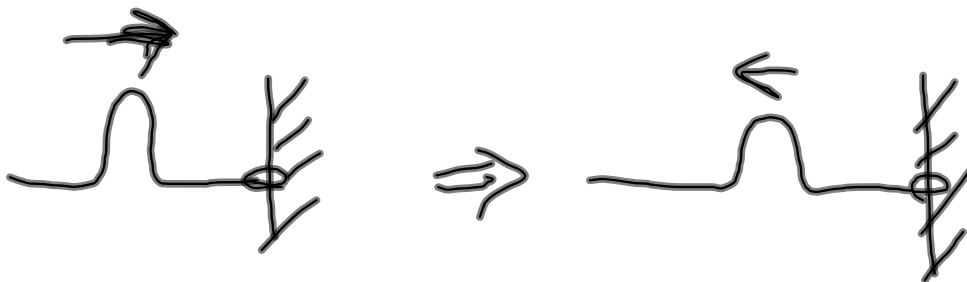
Reflections at a boundary:

– Fixed end: the wave

"flips" the direction of the
amplitude



– Free end: the wave's amplitude
stays the same direction



Sound:

- Pitch \rightarrow perceived frequency of the sound

- how high or low something sounds

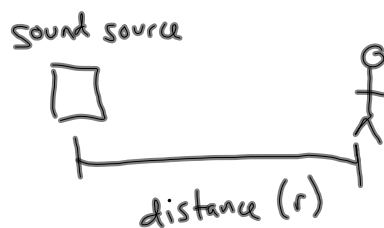
- Intensity \rightarrow how loud something sounds
measured in W/m^2

$$I = \frac{P}{4\pi r^2}$$

\rightarrow power

\rightarrow intensity

\rightarrow distance from source



- From point sources (think firework),
Sound radiates in a sphere.

(In equation, $4\pi r^2$ = surface area of a sphere.)



$$I_1 > I_2 > I_3$$

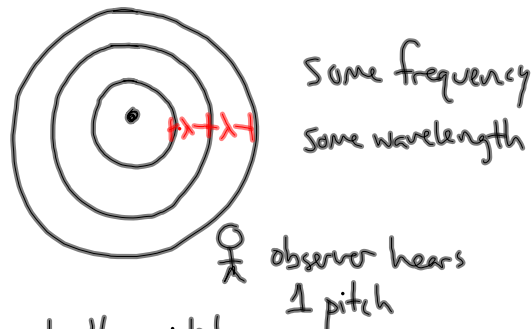
- Sound travels fastest through solids.

This is from the fact that the molecules are more dense in solids than in liquids or gases.

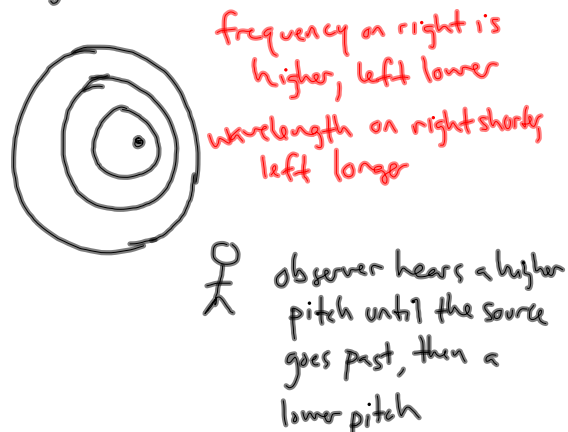
$$v_{\text{solid}} > v_{\text{liquid}} > v_{\text{gas}}$$

- Doppler effect

- Stationary source:

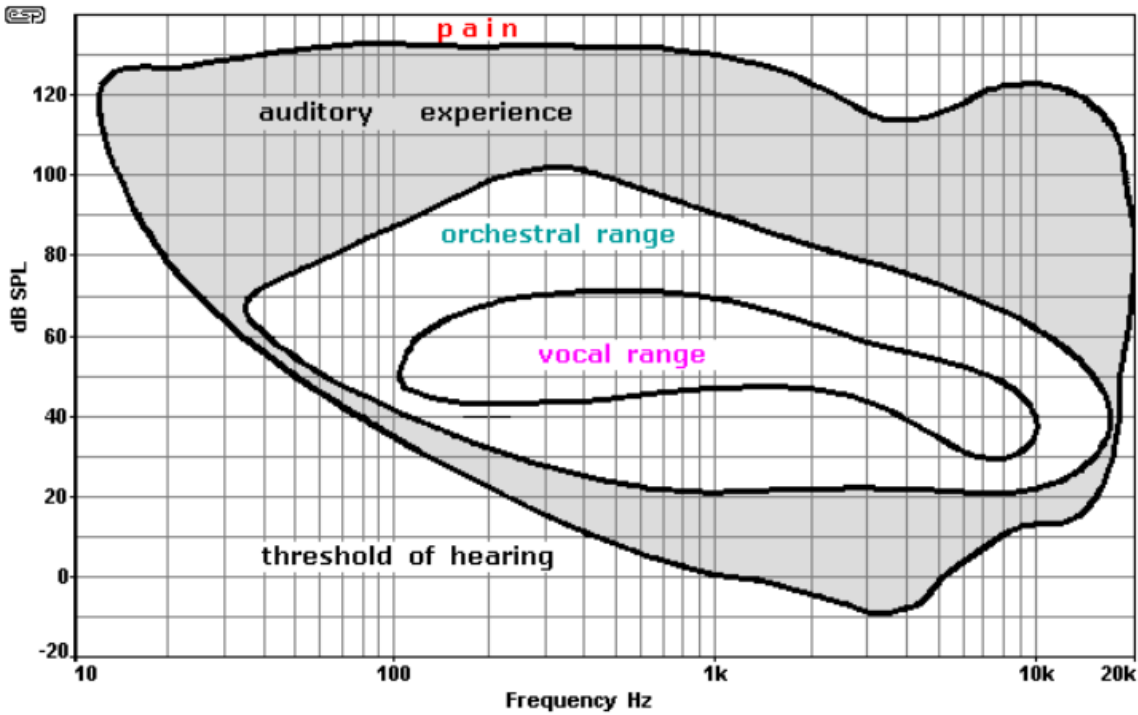
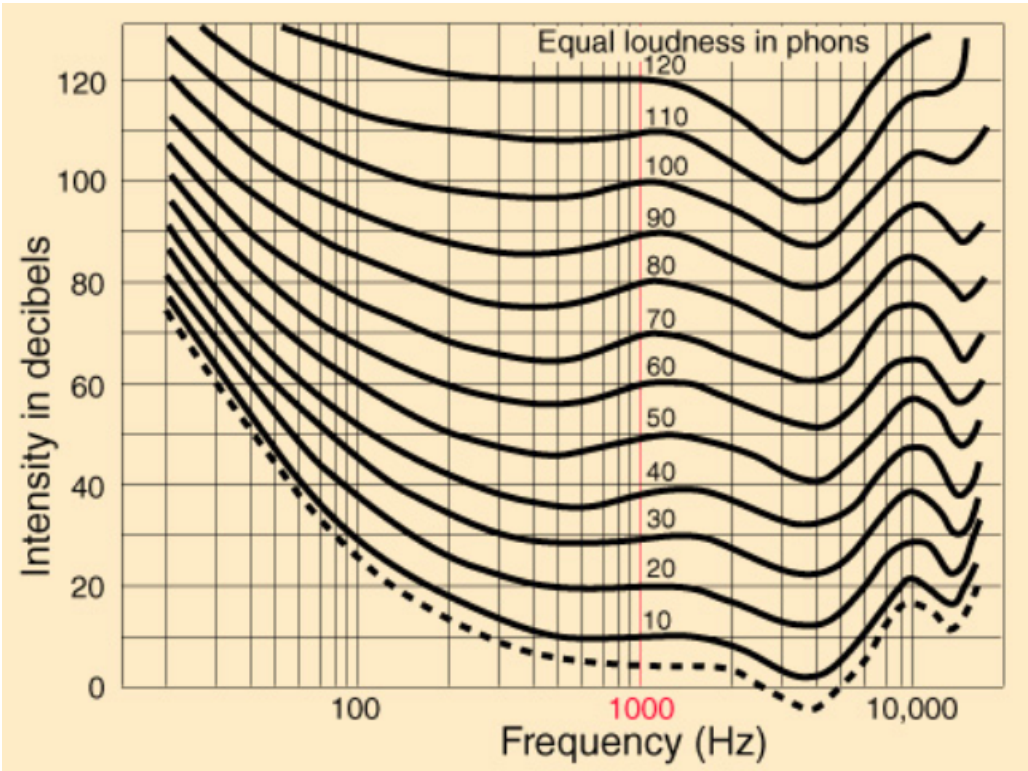


- Moving to the right:

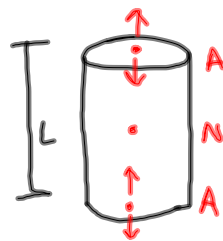


- If source is moving towards you, you will hear a higher frequency.

If source is moving away from you, you will hear a lower frequency.



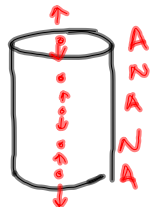
• Open/Open pipe:



1st order frequency

$$f_1$$

$$\lambda_1 = 2L$$



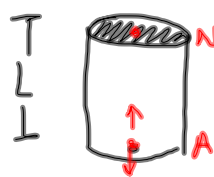
2nd order frequency

$$f_2 = 2f_1$$

$$\lambda_2 = L$$

$$f_n = \frac{nv}{2L} \quad n=1, 2, 3, \dots$$

• Open/Closed pipe:

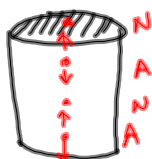


1st order frequency

$$f_1$$

$$\lambda_1 = 4L$$

- we must have an antinode at the open part of the pipe, so we only get odd frequencies. The even frequencies do not exist.



3rd order frequency

$$f_3 = 3f_1$$

$$\lambda_3 = \frac{4}{3}L$$

$$f_n = \frac{nv}{4L} \quad n=1, 3, 5, 7, \dots$$

Sound, EM Spectrum, Reflection Notes 4.30.12 CP Physics

What are the first three order frequencies in a 2.45 m long pipe that is open at both ends? What are the first three order frequencies of this pipe when one end of the pipe is closed? Assume that the speed of sound in air is 345 m/s.

- open/open $\rightarrow n = 1, 2, 3$

$$f_n = \frac{nv}{2L} \quad v = 345 \text{ m/s} \quad L = 2.45 \text{ m}$$

$$f_1 = 70.4 \text{ Hz}$$

$$f_2 = 140.8 \text{ Hz}$$

$$f_3 = 211 \text{ Hz}$$

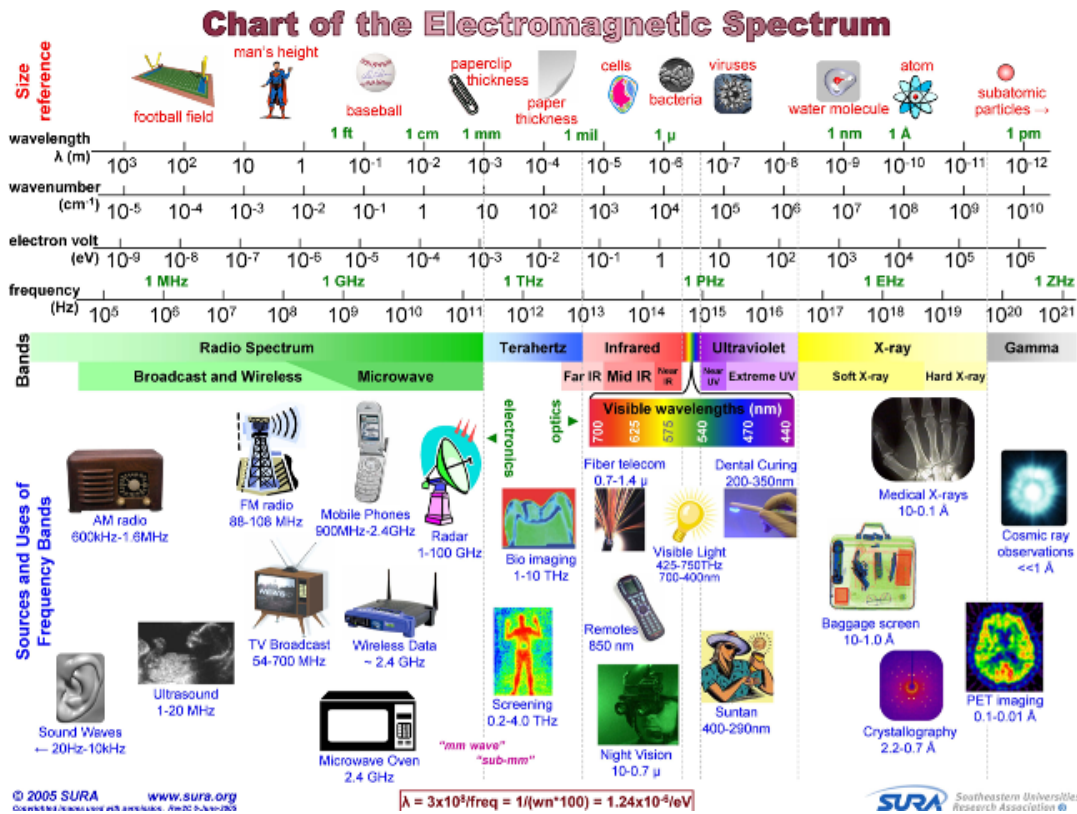
- open/closed $\rightarrow n = 1, 3, 5$

$$f_n = \frac{nv}{4L}$$

$$f_1 = 35.2 \text{ Hz}$$

$$f_3 = 105.6 \text{ Hz}$$

$$f_5 = 176 \text{ Hz}$$



• Light is technically known as electromagnetic radiation.